



# **Detailed Costing Document For The Centralized Waste Treatment Industry**

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## **DETAILED COSTING DOCUMENT FOR THE CWT POINT SOURCE CATEGORY**

In this document, EPA presents the costs estimated for compliance with the proposed CWT effluent limitations guidelines and standards. Section 1 provides a general description of how the individual treatment technology and regulatory option costs were developed. In Sections 2 through 4, EPA describes the development of costs for each of the wastewater and sludge treatment technologies.

In Section 5, EPA presents additional compliance costs to be incurred by facilities, which are not technology specific. These additional items are retrofit costs, monitoring costs, RCRA permit modification costs, and land costs.

### **SECTION 1 COSTS DEVELOPMENT**

#### **1.1 Technology Costs**

EPA obtained cost information for the technologies selected from the following sources:

- the data base developed from the 1991 Waste Treatment Industry (WTI) Questionnaire responses (This contained some process cost information, and was used wherever possible.),
- technical information developed for EPA rulemaking efforts such as the guidelines and standards for: the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) category, Metal Products and Machinery (MP&M) category, and Industrial Laundries industries category,
- engineering literature,
- the CWT sampling/model facilities, and
- vendors' quotations (used extensively in estimating the cost of the various technologies).

The total costs developed by EPA include the capital costs of investment, annual O&M costs, land requirement costs, sludge disposal costs, monitoring costs, RCRA permit modification costs, and retrofit costs. Because 1989 is the base year for the WTI Questionnaire, EPA scaled all of the costs either up or down to 1989 dollars using the Engineering News Record (ENR) Construction Cost Index.

EPA based the capital costs for the technologies primarily on vendors' quotations. The standard factors used to estimate the capital costs are listed in Table 1-1. Equipment costs typically include the cost of the treatment unit and some ancillary equipment associated with that technology. Other investment costs in addition to the equipment cost include piping, instrumentation and controls, pumps, installation, engineering, delivery, and contingency.

Table 1-1. Standard Capital Cost Algorithm

Factor	Capital Cost
Equipment Cost	Technology-Specific Cost
Installation	25 to 55 percent of Equipment Cost
Piping	31 to 66 percent of Equipment Cost
Instrumentation and Controls	6 to 30 percent of Equipment Cost
<i>Total Construction Cost</i>	Equipment + Installation + Piping + Instrumentation and Controls
Engineering	15 percent of Total Construction Cost
Contingency	15 percent of Total Construction Cost
<i>Total Indirect Cost</i>	Engineering + Contingency
<i>Total Capital Cost</i>	Total Construction Cost + Total Indirect Cost

EPA estimated certain design parameters for costing purposes. One such parameter is the flow rate used to size many of the treatment technologies. EPA used the total daily flow in all cases, unless specifically stated. The total daily flow represents the annual flow divided by 260, the standard number of operating days for a CWT per year.

EPA derived the annual O&M costs for the various systems from vendors' information or from engineering literature, unless otherwise stated. The annual O&M costs represent the costs of maintenance, taxes and insurance, labor, energy, treatment chemicals (if needed), and residuals management (also if needed). Table 1-2 lists the standard factors EPA used to estimate the O&M costs.

Sections 2 through 4 present cost equations for capital costs, O&M costs, and land requirements for each technology and option. EPA also developed capital cost upgrade and O&M

cost upgrade equations. EPA used these equations for facilities which already have the treatment technology forming the basis of the option (or some portion of the treatment technology) in-place.

Table 1-2. Standard Operation and Maintenance Cost Factor Breakdown

Factor	O&M Cost (1989 \$/YR)
Maintenance	4 percent of Total Capital Cost
Taxes and Insurance	2 percent of Total Capital Cost
Labor	\$30,300 to \$31,200 per man-year
Electricity	\$0.08 per kilowatt-hour
Chemicals:	
Lime (Calcium Hydroxide)	\$57 per ton
Polymer	\$3.38 per pound
Sodium Hydroxide (100 percent solution)	\$560 per ton
Sodium Hydroxide (50 percent solution)	\$275 per ton
Sodium Hypochlorite	\$0.64 per pound
Sulfuric Acid	\$80 per ton
Aries Tek Ltd Cationic Polymer	\$1.34 per pound
Ferrous Sulfate	\$0.09 per pound
Hydrated Lime	\$0.04 per pound
Sodium Sulfide	\$0.30 per pound
Residuals Management	Technology-Specific Cost
<i>Total O&amp;M Cost</i>	Maintenance + Taxes and Insurance + Labor + Electricity + Chemicals + Residuals

## 1.2 Option Costs

EPA developed engineering costs for each of the individual treatment technologies which comprise the CWT regulatory options. These technology-specific costs are broken down into capital, O&M, and land components. To estimate the cost of an entire regulatory option, it is necessary to sum the costs of the individual treatment technologies which make up that option. In a few instances, an option consists of only one treatment technology; for those cases, the option cost is obviously equal to the technology cost. The CWT subcategory technology options are shown in Table 1-3. The treatment technologies included in each option are listed, and the subsections which contain the corresponding cost information are indicated.

EPA generally calculated the capital and O&M costs for each of the individual treatment technologies using a flow rate range of 1 gallon per day to five million gallons per day. However, the flow rate ranges recommended for use in the equations are in a smaller range and are presented for each cost equation in Sections 11.2 through 11.4 of the Development Document for the CWT Point Source Category.

Table 1-3. CWT Treatment Technology Costing Index - A Guide to the Costing Methodology Sections

Subcategory/ Option	Treatment Technology	Section
Metals 2	Selective Metals Precipitation	2.1.1
	Plate and Frame Liquid Filtration	2.2.1
	Secondary Chemical Precipitation	2.1.2
	Clarification	2.2.2
	Plate and Frame Sludge Filtration	4.1
	Filter Cake Disposal	4.2

Subcategory/ Option	Treatment Technology	Section
Metals 3	Selective Metals Precipitation	2.1.1
	Plate and Frame Liquid Filtration	2.2.1
	Secondary Chemical Precipitation	2.1.2
	Clarification	2.2.2
	Tertiary Chemical Precipitation and pH Adjustment	2.1.3
	Clarification	2.2.2
	Plate and Frame Sludge Filtration	4.1
	Filter Cake Disposal	4.2
Metals 4	Primary Chemical Precipitation	2.1.4
	Clarification	2.2.2
	Secondary (Sulfide) Chemical Precipitation	2.1.5
	Secondary Clarification (for Direct Dischargers Only)	2.2.2
	Multi-Media Filtration	2.5
	Plate and Frame Sludge Filtration *	4.1
Metals - Cyanide Waste Pretreatment	Cyanide Destruction at Special Operating Conditions	2.6
Oils 8	Dissolved Air Flotation	2.8
Oils 8v	Dissolved Air Flotation	2.8
	Air Stripping	2.4
Oils 9	Secondary Gravity Separation	2.7
	Dissolved Air Flotation	2.8
Oils 9v	Secondary Gravity Separation	2.7
	Dissolved Air Flotation	2.8
	Air Stripping	2.4
Organics 4	Equalization	2.3
	Sequencing Batch Reactor	3.1
Organics 3	Equalization	2.3
	Sequencing Batch Reactor	3.1
	Air Stripping	2.4

\* Metals Option 4 sludge filtration includes filter cake disposal.

### *1.2.1 Land Requirements and Costs*

EPA calculated land requirements for each piece of new equipment based on the equipment dimensions. The land requirements include the total area needed for the equipment plus peripherals (pumps, controls, access areas, etc.). Additionally, EPA included a 20-foot perimeter around each unit. In the cases where adjacent tanks or pieces of equipment were required, EPA used a 20-foot perimeter for each piece of equipment, and configured the geometry to give the minimum area requirements possible. The land requirement equations for each technology are presented throughout Sections 2 to 4. EPA then multiplied the land requirements by the corresponding land costs (as detailed in 5.4) to obtain facility specific land cost estimates.

### *1.2.2 Operation and Maintenance Costs*

EPA based O&M costs on estimated energy usage, maintenance, labor, taxes and insurance, and chemical usage cost. With the principal exception of chemical usage and labor costs, EPA calculated the O&M costs using a single methodology. This methodology is relatively consistent for each treatment technology, unless specifically noted otherwise.

EPA's energy usage costs include electricity, lighting, and controls. EPA estimated electricity requirements at 0.5 kWhr per 1,000 gallons of wastewater treated. EPA assumed lighting and controls to cost \$1,000 per year and electricity cost \$0.08 per kWhr. Manufacturers' recommendations form the basis of these estimates.

EPA based maintenance, taxes, and insurance on a percentage of the total capital cost as detailed in Table 1-2.

Chemical usage and labor requirements are technology specific. These costs are detailed for each specific technology according to the index given in Table 1-3.